

ANNALS OF SURGERY.

FOREIGN BODIES IN THE LUNGS.

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IN the battle at Vertienshoomen on the 17th of April, 1900, Mr. H., aged twenty-three years, was wounded in several places by fragments of a lyddite-shell exploding at a few paces' distance. One of the fragments struck him in front of the right shoulder, and in a medial direction penetrated between the second and the third ribs into the right lung.

Examinations by means of X-rays, afterwards confirmed by the operation, showed that this fragment had stopped behind the medial part of the second rib, about 7.5 centimetres behind the front wall of the thorax, and had probably been retained there by the resistance offered by the right main bronchus, together with the large blood-vessels.

At first there were scarcely any symptoms of wounding of the lungs. The wounded man ran as fast as his other wounds permitted over a distance of about 2000 paces, cried with all his might and, as he declared himself, as loud as ever, and was actually heard at a considerable distance. Not until several hours afterwards, when he had been carried away and had had all his other wounds dressed, did he become oppressed, and with open mouth panted for breath. But the oppression soon gave way, and in the evening he could speak again, though with some difficulty. A further five hours' transport over rocks and through ravines, which he went through the next day, did not produce any symptoms to show that he had sustained a wound of his lungs.

This is very different from what was experienced both on the Boer and on the English side in the Transvaal in cases of transport of men suffering from wounded lungs. For such

wounded people the most absolute rest is an imperative necessity. The deeper the English army in its rapid march from Modderrivier to Bloemfontein penetrated into the enemy's country, and the farther the wounded soldiers had to be carried back to the great hospitals, the more grave became the general process of the disease in cases of wounds in the lungs. Thus, for instance, haematothorax as a complication increased from 30 per cent. to 90 per cent. ("Surgical Experiences in South Africa, 1899-1900," by Makins, 1901.)

That the transport over so great a distance had no bad effect in this case may be accounted for by the exceptional character of the wound. The large projectile, 4.5 centimetres in greatest dimension, penetrated only to a comparatively little distance into the body; its impact must consequently have been slight. The wound was therefore chiefly a laceration, which, as is well known, is rarely attended with much bleeding.

Unlike the other wounds, the wound in the breast rapidly healed, and in no way required particular treatment. A few days after the wounding, the man coughed up dirty, stinking blood; but the irritation and the expectoration soon decreased. Now and then some rare phlegm came up, at first sometimes of a nauseous, sweetish taste. But after a few weeks this also ceased altogether, and the patient might have thought the wound in his breast completely healed, but that attempts at deep breathing continued to give him pain, which caused him to restrain himself from sneezing as much as possible. One day in June, however, he was seized with a fit of sternutation. He immediately felt something warm in his throat, and upon coughing expectorated some pure blood. From that time on the bloody expectorations repeated themselves, and finally, by the advice of Dr. Bierens de Haan, the patient resolved to go to Holland to undergo an eventual operation.

On the 5th of October, about six months after the wounding, the patient presented himself at the Municipal Hospital at Amsterdam. It was then found that the top of the right lung both in front and at the back emitted a deadened tympanitic percussion-tone, while at the same time before and behind crepitant and sonorous râles were heard. Now and then bloody purulent sputa came up. Any movement of the body, even riding in a tram-car, caused the bloody coughing to increase. The X-rays confirmed

the presence of a foreign body in the lungs, and even one of considerable size. It was found easy to determine pretty accurately the place of the projectile with respect to the thorax. A distinct part of the shadow was covered with the shadow of a small leaden ball, moved to and fro successively on the back and on the breast. The place of this ball was then marked on the skin, both of the back and of the breast. Then the patient was turned with respect to the light-giver and the same process of determination repeated. The line *a b* measured by means of calipers had then only to be divided in the ratio of *a c* and *b d*. (Fig. 1.) The distance of the shell to the front wall of the thorax, measured in this way, was 7.5 centimetres.

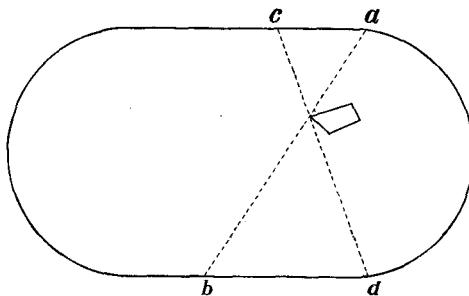


FIG. 1.—Showing distance of shell to front wall of thorax.

Would it be advisable to wait for untoward symptoms before interfering? A consultation of hand-books on military surgery did not give any light. Küttner, in his South African experiences (Bruns, *Beiträge zur klinischen Chirurgie*, Vol. xxviii), does not mention projectiles retained in the lungs. Makins (*loc. cit.*, p. 401) holds that bullets of small calibre are rarely retained in the thoracic cavity. Shrapnel-bullets and fragments of shells, however, were more commonly retained. "The rules to be followed in such cases do not materially deviate from those to be observed in the body generally." "When the bullet is causing no trouble, . . . no interference is advisable. In case of lodgement of the bullet in the lung, bearing in mind the infrequency of untoward symptoms, the latter should be watched for prior to interference."

I am of a different opinion; and I hold that a bullet, as

well as any other foreign body in the lung, deserves attention, even if at first no alarming symptoms should appear. I am strongly convinced that the simple presence of any body in the lungs is to be considered dangerous, and that the only way to prevent operative cures from coming too late is to consider of the highest importance even the slightest symptoms that should manifest themselves.

A few years ago (1896), Hoffmann ("Die Krankheiten der Bronchien, 1896," in Nothnagel's "Specielle Pathologie und Therapie") once more collected the statistics of foreign bodies inhaled into the lungs. He collected some 160 cases, which he classified according to the nature of the bodies. On perusing these lists, we find that if once the foreign body has been expectorated either spontaneously or after tracheotomy, the result was almost generally perfect cure, even after months. Still, the character of the suffering becomes generally the more serious the longer the foreign object had remained in the lungs. In several instances mention is made of expectoration of pus and of the breaking of an abscess in the lungs. Among five cases, in which a sharp-edged, hard body was brought up by coughing after six months or longer, only one patient was completely cured; in two cases the expectoration of pus continued, and in the two remaining cases the end was death from pulmonary disease.

In one of the last two cases a small bone was expectorated after seventeen years, and death followed eighteen months afterwards; in the other case a tooth was expectorated after two years and six months, and the patient died a year after. Only once in all these 160 cases mention is made of a dubious cure without the foreign body being removed either by extraction, by expectoration, or by suppuration. In all the other sixty cases in which the body remained in the lungs, death ensued after a shorter or longer period.

It was an exception, if any patient died within the first hours or days by suffocation. This only occurred with such foreign bodies as are apt to swell, such as beans. Of twenty-nine such cases only twelve were cured, whilst of seventeen of

the persons who succumbed, seven died within the first two days, *i.e.*, by suffocation. Some patients died from suffocation after inhaling fruit-kernels. But among sixty-eight patients who had inhaled sharp-edged and pointed objects, we do not find one who died from suffocation. Speedy death followed in thirty cases as the result of further complications, four times even after the object had been coughed up. Among these four are the two we have mentioned above. Suppuration, hectic fevers, coughing with bloody expectorations, and cerebral abscesses are found to have been quite frequent in such cases. As foreign bodies, the inhaling of which was the cause of death, we frequently find small bones, next a set of false teeth, an earring, a bit of slate-pencil, a shirt-pin, but also in two cases pieces of glass, and once a Louis-d'or—bodies which in themselves perfectly admit of being compared with a metal projectile.

From a careful consideration of these data we conclude, in general, that foreign bodies entering through the larynx, if they do not soon cause death by suffocation, may sometimes be borne easily enough for some length of time; that where they are smooth and round and not too large, they are commonly coughed out or removed by tracheotomy; that where angular bodies are soon removed by tracheotomy or by spontaneous expectoration the patient's condition may present a good prognostic, even if the objects have only been removed after months, when suppurating processes had already developed; that the longer the object remained in the lungs, the more serious the consequences were, and that in all cases in which the body definitively remained in the lungs, the final result was the patient's death. Left to itself, any permanently retained body kills the patient slowly but surely. Nor is it difficult to see that it must necessarily be so. Around the foreign body follows decubitus, and behind it retention of mucus; the ensuing inflammation and swelling can only make the situation worse. The increasing retention of mucus and the existing decubitus render the danger of infection more and more serious. In some cases ulceration will

prevail, in others the symptoms of retention of pus and formation of abscesses will be predominant. Besides, the infiltrated bronchus will lose its elasticity and become distended, partly by the forced pressure of expiration in coughing, when the air behind the stenosis comes under higher tension, partly by the continually active atmospheric over-pressure, or, which comes to the same thing, by the negative pressure of the surrounding tissues. In this way bronchial ectases are formed, which are at first somewhat limited, but soon become, under the influence of the same circulus vitiosus, progressive. Lobular pneumonia can only accelerate the destruction of the part of the lungs behind the foreign body.

As soon as this vicious circle of swelling, stenosis, retention of pus, ulceration, and dilatation has clearly begun and is continuing in progress, there is no means to stop the course of the destruction process. Whenever the patient changes his position, large quantities of stinking pus flow in a few moments from the bronchial cavities into the trachea, under the influence of the reflex cough overflow the higher respiratory organs and are thrown out. Sometimes the bleedings become alarming even at an early stage. Hectic fevers exhaust the patient's strength. Percussion and auscultation point to a well defined cavern, which in the end comes near the surface and can be reached by means of an aspiration-needle. As it becomes clearer and clearer that no cure is at all possible without operative treatment, an operation is readily resolved upon, now that the pus is attainable. But even then this operation is anything but simple. A *prima facie* drawback is that in this case, unlike what we find in other pulmonary processes which may necessitate operation (formation of gangrene or of abscesses, after acute pneumonia), there is very rarely any growing together between the two pleural membranes. For the suppurating process is in the centre, and consequently it is only in the very last stage that it attacks the periphery of the lungs.

After a rib resection, which, to facilitate careful examination, must be made somewhat extensive, a large part of the

pleura costalis is laid bare, and, the wound having been tamponed, we wait till the pleural membranes have come to grow together under the influence of the inflammation of the wound. This takes about a fortnight. But during this fortnight the patient is in far worse condition than he was before the operation. By operating without narcosis, the patient may indeed have been secured against extension of the suppurating process by the aspiration of stinking pus into parts of the lungs that had been sound till now. But the same danger is imminent after the operation. Before the operation indeed the patient was in continual fear that every change of position on his part, or the first attempt at coughing, would bring about the evacuation of the quantities of pus which had gathered during his sleep. He dreads the horrid smell and taste of the stuff, and knows that, if very large quantities are brought up, he may be in danger of being suffocated.

But after the operation he also suffers from the pain which the wound of the resected ribs is sure to cause. Hence, a greater dread of expectoration on his part and increased retention of pus with all its concomitants. High fevers, pneumonias, even cerebral embolisms in consequence of suppuration of pulmoenval thrombi, often appear after such first operations. One of my patients who had been operated without general anæsthesia for bronchial ectasy, died of pneumonia a few days after the preparatory operation. In another, a female patient, the symptoms of a cerebral abscess manifested themselves a few days after the treatment of the lungs themselves had begun.

Even when these dangers are passed and the growing together of the two pleural membranes is well on its way, we are not at the end of all difficulties. We put the case, that we have been successful in reaching the pulmonary cavity from without, and that it has been, or at least seemed to have been, sufficiently opened. For now it too often appears that only a very small quantity of pus is discharged through the draining tube, while the bulk of it is expectorated as before.

Moreover, in only one case of Tuffier's statistics (Chirur-

gie du poumon, 1897) was the foreign body itself removed through the wound. Considering that it is generally retained in a main branch of a bronchus, we readily see that its place is too far from the surface for it to be reached in this way. This explains at once why, though the operation may be said to have in a way succeeded, yet no decided benefit is obtained. The operation was intended only to open the ectatic bronchial tree, perhaps even a greatly widened branch of it; but the whole tree, with the foreign body attached to its stem, did not find any discharge worth mentioning along this single branch.

Still, out of eight such operations, it has been my good fortune to obtain nearly complete cures in three cases. Two of these operations took place in cases of bronchial ectasy in consequence of pieces of bone which the patients had swallowed, which bones themselves had probably in both cases already been coughed up, while the third operation was on a pulmonary abscess open to the side of the bronchus, and resulting from pneumonia. Several influences operate together in such cures. The newly made opening serves as a place for the discharge of pus; the air that is sucked in there ventilates the bronchial ectatic cavity; by means of Waldenburg's apparatus I had this air, impregnated with vapors of turpentine and iodoform, forced through the fistula in large quantities.

Through the extensive rib resection the side of the chest above the pulmonary cavity loses its rigidity, the cavity of the lungs can collapse and more completely void itself by expectoration. If the rib resection has been very extensive, the negative pressure in this part of the lung ceases, which caused the inflamed bronchial membrane to be continually distended; thus one of the mechanical causes of progressive formation of bronchial ectasy is removed. The coughing-fits indeed may continue with all their injurious effects, and, since the sick part of the lungs does not find any support, the cough may even have the more dilating power; but the coughing stimulus itself has decreased, and the resistance of the healing bronchial membrane has increased.

With what difficulties, however, such cures are attended

appears from Tuffier's (*loc. cit.*) statistics about the results of external operative treatment of diseases resulting from the aspirations of foreign bodies. In eleven operations four patients died shortly after the operation; not one patient was perfectly cured; only in one case the foreign body, an inhaled button, was removed by the operation, and this patient was cured, with retention of a fistula; in two cases the foreign bodies (a piece of sheep's bone and a hen's vertebra) were coughed up a few days after the operation, respectively fifteen months and two years and six months after the aspiration. Both patients improved so far as to be able to resume manual labor. In the first case, however, pus coughing continued, and in the second a fistula remained. In four other cases the foreign body was not removed; there was still less question of a cure, but the patients felt a great deal better. A twelfth case (Arnolds, *Ein Fall von Pneumotomie wegen Fremdkörper; Mittheilungen aus dem Grenzgebiete*, 1899, Band vi), in which the button was felt during the pneumotomy and was coughed up a short time afterwards, can be added to Tuffier's list. The ultimate result of this case has not been recorded.

We conclude that these late operations may improve the patient's condition, but they will not effect a cure. It is but natural that these unsatisfactory results induced surgeons to try to remove such foreign bodies as were not soon coughed up before suppuration and bronchial ectasy manifested themselves (Tuffier). But this is easier said than done. Only of late, now that by the Röntgen rays the localization of the foreign body has become possible, we can think of operating in this way with any hope of success; for the aspirated foreign body is always very far from the surface of the lung. To reach it, it is indispensable to open a passage not only through the cavity of the pleura, but also through a thick layer of sound pulmonary tissue. The passage has to go straightway to the foreign body, for there can be no question of finding anything by seeking in the depth of a long, narrow wound. Arnolds records that Bardenheuer was the first to operate at once in such a case, and not quite unsuccessfully.

On March 19, 1898, a cook, T. B., aged twenty-three years, aspirated an artificial tooth. Dreadful coughing spasms followed directly, which repeated themselves for five days with decreasing violence. Not until the fifth day did she apply for assistance, and by means of the X-rays her statement was confirmed, and the exact place of the foreign body ascertained. From the measured displacement of the shadow with a given displacement and a given distance from the light-giver, the distance from the tooth to the back wall of the thorax was estimated at ten centimetres. For two months the foreign body remained lying there unaltered opposite the right seventh rib. According to anatomical investigations, it must have got into a bronchial branch of the third order. In accordance with this was the fact that in case of deep inspiration and expiration the shadow was displaced at least three centimetres, *i.e.*, the body itself at least two and a half centimetres. A spontaneous coughing-up after an unchanged fixation for so long a period was certainly very improbable. In the conviction that delay could be of no use before a large part of the pulmonal tissues had been destroyed, and that it was imperatively necessary to prevent this, it was resolved to proceed to the operation. The 18th of May rib resections were made, measuring five centimetres, from the sixth, the seventh, and the eighth rib, and three centimetres from the ninth rib. Tamponing of the wound till the 8th of June. Then, after having once more examined by means of X-rays, and ascertained once more its exact location, a needle was introduced ten centimetres, and immediately the firm resistance of the hard body was felt. In the same direction a Paquelin was introduced. Having got so far, the needle no longer met with any resistance, consequently the operation was suspended and the wound tamponed again.

On the 30th of June, examination of the lung with X-rays was made while a probe was introduced into the long Paquelin wound. The tooth was found to lie two centimetres above the point of the probe. In accordance with this the Paquelin was introduced. With the probe a hard body was distinctly felt. Tamponing on account of bleeding. Four hours afterwards the tooth was coughed up. The wound healed rapidly.

If in this case the foreign body was not extracted from the pneumotomy wound, the object of the operation, removing the tooth from the lungs, was fully attained.

Returning to our patient, we repeat the question, whether it might be considered advisable to wait any longer. There was an undoubted connection between the bronchial tree and the cavity of the projectile, as was clearly proved by the continually repeated bleedings. The expectorations were at first stinking, and now brown suppurating phlegm was very often brought up. Consequently, there had been infection, and from the last symptoms it might be readily concluded that the infection was there still. Besides, the crepitant and sonorous râles, which manifested themselves in great numbers in the right top, clearly proved that there was something more than compression of pulmonary tissues. Consequently, I took this foreign body to be in the same condition as any other body that had entered through the trachea. But in this case coughing out was next to an impossibility, and bringing out by the formation of an abscess in the chest wall was almost as improbable. It is true that among 160 cases Hoffman had recorded seven cures in this manner, but the objects in question were all of them grains of corn. In a total of seventeen cases relating to grains of corn, still in an eighth case it appeared that the pulmonary abscess extended as far as the liver. It would therefore appear that grains of corn—in consequence of their shape and their tendency to move on in one direction—have a special predisposition to make their way from within by means of an abscess, even if they should have to travel a long way, in one case even to the renal region.

But considering that no such cure was ever effected in the case of any other foreign body, in our case, with so large a shell-splinter, it was not to be thought of. The body had entered from without, but was too large to return the same way. Would not, in general, a bullet having lodged itself in the lungs by penetrating to the more solid parts of the hilus present the same conditions?

If the cavity in which such a body is lodged should be ever so slightly connected with the bronchial tree, I think there must always be a tendency to an enlargement of the cavity and to an increase of the retention of mucus and afterwards of pus.

For a long time the bullet may seemingly cause little trouble; there is always, I think, every reason to fear that finally, like all foreign bodies in the lungs, it will cause progressive destruction of pulmonary tissue, ending in death. That is the reason why in this case I held a bloody removal to be peremptorily indicated.

On the 17th of October the second rib was resected from the cicatrix nearly to the sternum. Then all the tissues of the second intercostal space with the cicatrix in it were cut away. Neither the second nor the third rib was found fractured. Consequently, the shell-splinter must have passed between the two ribs. In trying to follow the cicatrix into the lungs, the pleural cavity was opened; immediately a moist tampon was applied, and the patient's wound dressed. Up to the 29th of October the patient was made to lie on his belly, lest the heavy splinter should come to lie at a greater distance from the front wall of the chest, and thus become fixed.

On the 30th of October another radiographic examination, with the same result as before. It will be necessary to make the perforation along the remaining sternal part of the rib.

On the 31st of October second operation. After one or two unsuccessful attempts, three pins were successively introduced, all of them parallel and at a distance of two centimetres from each other; all struck against a hard object at a depth of four centimetres. Above and under this spot, as deeply as possible by means of full curved needles, thread-loops were passed, with which the deeper tissues were entwined and brought to the surface; all exploratory pins having been removed, these pulmonary tissues were cut. Once more thread-loops were passed and the entwined tissues cut. Then the point of the knife was arrested by the hard body, and dilatation of the incision with director and forceps was made. The finger being introduced, continued the dilatation with the aid of the forceps; the splinter was taken hold of and extracted. Upon further examination there follow still two pieces of cloth. The whole cavity was eleven centimetres deep. Loose tamponing.

On the following days the patient coughed up some bloody sputa, and the wound was dressed every day. In case of cough-

ing, the air flowed out. On the 14th of November, as the wound was being dressed, another piece of cloth was coughed out and removed. On the 1st of December the wound was rapidly healing, and no longer left any passage for the air.

On the 13th of December the patient was discharged as cured. Still, every morning one or two slimy masses of phlegm were expectorated. After a fortnight this did not occur any more, and the patient was in perfect health. On percussion the sound was found somewhat deadened. Auscultation showed weakened

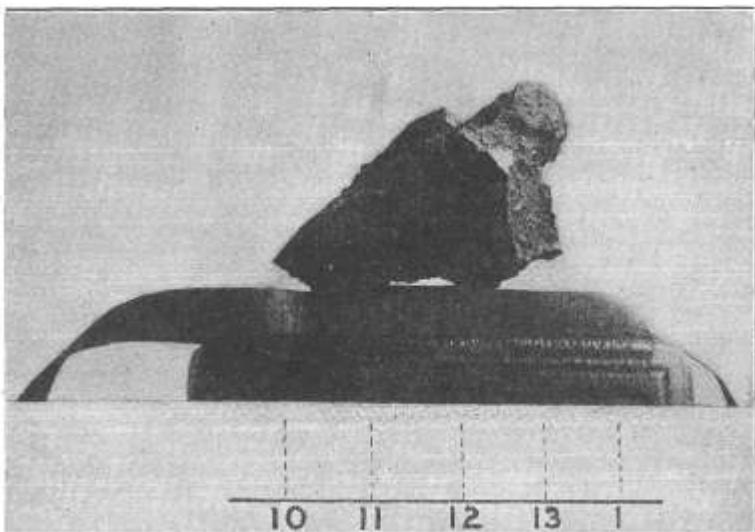


FIG. 4.—Piece of shell weighing forty-two grammes. Removed from lung.

breathing. On the 21st of August, 1901, the most favorable reports were received.

The splinter measures four and a half centimetres in longest dimension, presents a regular upper and under side, with very irregular, sharply-pointed breaking edges, and is about one and a half centimetres thick (Fig. 4). It weighs forty-two grammes.

According to Tuffier's statistics (1897) and Arnolds's paper (1899), this would be the second foreign body extracted from the lungs through an external wound, and this case of

pneumotomy is also the second that may lay claim to the name of "early" operation.

That foreign bodies deeply aspired can also be removed through the trachea has been proved by von Schrötter, who, in the case of a boy of twelve, removed a piece of lead of 3.2 grammes from a bronchial branch of the second order. Under cocaine anaesthesia, von Schrötter introduced a straight tube twenty-four centimetres in length and 6.3 millimetres in diameter through larynx, trachea, and bronchus. At the end of the tube the piece of lead became visible; finally, it was seized by means of a forceps expressly made for the purpose, and removed at the same time with the tube. ("Zur casuistik der Fremdkörper in den Luftwegen," by Leopold von Schrötter, 1901.)